National Aeronautics
and
Space Administration

High Contrast Coronagraph Testbed

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Project Objectives

- Advance the readiness of space coronagraph hardware, techniques, algorithms, and performance models,
- Provide proof-of-concept laboratory demonstrations of high-contrast coronagraph techniques, and
- Support collaborations across the exoplanet community in pursuit of the optimal space coronagraph architecture.

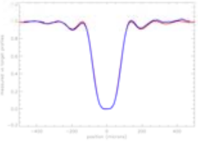
Recent Results

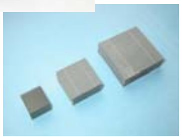
- Demonstrated contrast (exoplanet/star) ratios of better than 2e-9 in 10% bandwidth light for a variety of coronagraph types,
- Demonstrated open-loop contrast stability of 1e-11 over periods of 5 hours or more,
- Facilitated the refinement of coronagraph imaging techniques and precision wavefront sensing and control algorithms in a space-like operating environment,
- Collaborated with Princeton University, University of Arizona, and NASA Ames.

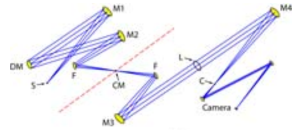
Project Description

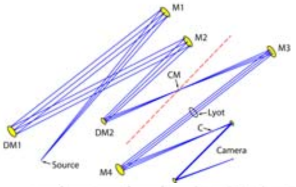
At left: coronagraph testbed resides in a vacuum chamber that provides a space-like operating environment.

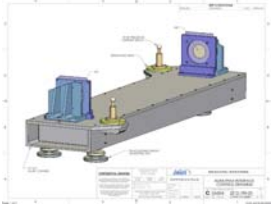
At right: New technologies are tested and validated on the testbed, including precision deformable mirrors capable of 0.01 nm surface figure control, and metallic occulting masks for broadband (20% bandwidth) imaging.





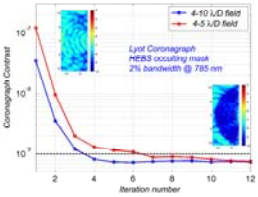




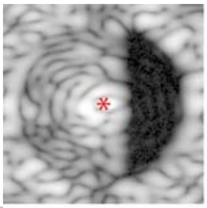


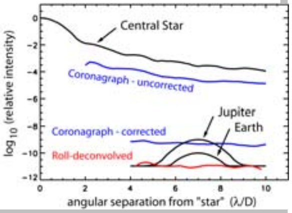
At left: The testbed can be reconfigured for a variety of coronagraph architectures. Shown from top to bottom are (top) current configuration with a single 32mm DM, (middle) new configuration with a 64mm and 32 mm DM in series, and (bottom) a new configuration that will accommodate pupil remapping (PIAA) coronagraphy.

Below center: Wavefront control algorithms uses only information available at the science focal plane, a method can be used in the space coronagraph mission.



At right: coronagraph has demonstrated contrast and open-loop stability for the detection of Earth-like exoplanets.





Benefits to NASA and JPL

- Development of new coronagraph technologies leading to a space mission for the direct imaging and spectroscopy of exoplanet systems orbiting the nearby stars.
- Precision wavefront control, as pioneered at JPL with the HCIT, is an enabling technology required for all coronagraph architectures, including classical band-limited Lyot, shaped/apodized pupil, pupil-remapping (PIAA), and vortex phase-mask coronagraphs.

Publications

- "A laboratory demonstration of the capability to image an Earth-like extrasolar planet", J. Trauger & W. Traub, Nature 446 (2007).
- "Laboratory demonstrations of high-contrast imaging for space coronagraphy", J. Trauger, A. Give'on, B. Gordon, B. Kern, A. Kuhnert, D. Moody, A. Niessner, F. Shi, D. Wilson, C. Burrows, Proc. SPIE, 6693 (2007).